Assessing cetacean occurrence in the western Gulf of Alaska using passive acoustics

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Executive Summary

Three subsurface passive acoustic moorings were deployed in the western Gulf of Alaska on the EcoFOCI fall mooring cruise onboard the F/V Aquila 15 Aug – 14 Sep 2023; recovery is planned for September 2024, funding permitting. These mooring will allow investigation into the seasonal occurrence of many species of vocalizing marine mammals including North Pacific right (NPRW), blue, fin, humpback, minke, gray, sperm, killer, and beaked whales, Dall's and harbor porpoise, general pinniped sounds, and anthropogenic noise sources such as vessels and seismic airguns. This is important data that the Navy needs to prepare environmental planning documentation, including those for the National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), and ESA documents and consultations. It is also needed to inform the National Marine Fisheries Service Alaska Regional Office's NPRW critical habitat expansion decision.

In addition to the field work, processing of existing passive acoustic recordings from three moorings in the WGOA is ongoing, with one site (Barnabus Trough) completed for the high-frequency band. Killer whale vocalizations were detected on 214 of the 358 days with recordings. These killer whale calls will be included in our ecotype analyses.

Background

The Gulf of Alaska (GOA) provides critical military training space, including the Navy's Temporary Maritime Activities Area (TMAA) and Western Maneuver Area (WMA). Very limited cetacean occurrence, seasonality and density information is available in the region overlapping the Navy's WMA study area. The GOA provides important habitat for many cetaceans, both as a migratory thoroughfare and as an important feeding ground. Multiple species are targeted for research to support understanding of species occurrence of key cetacean stocks, including North Pacific right (NPRW), blue, sperm and fin whales, which are listed under the Endangered Species Act (ESA), along with unlisted stocks of beaked whales. The Navy is seeking acoustic occurrence data in the Gulf of Alaska and throughout the Navy's Northwest operation area to support the preparation of environmental planning documentation, including National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), and ESA documents and consultations.

In addition, the Alaska Regional Office of the National Marine Fisheries Service is in the process of revising the NPRW critical habitat in the Bering Sea and Western Gulf of Alaska. The data produced from this study will help to inform their final decision.

Objectives

The purpose of this study is to provide the Navy with occurrence and timing information on cetacean species in the GOA and the Navy's WMA. At least 15 species of cetaceans occur in the Gulf of Alaska. This includes five species of endangered large whales (eastern NPRW, blue, fin, sei, and sperm whales). In addition, at least two distinct populations of humpback whales use this area: the endangered western North Pacific distinct population segment (DPS) and the Hawaii DPS, which is not listed under the ESA. Two DPSs of gray whales migrate through the Gulf: the endangered Western North Pacific DPS and the unlisted Eastern North Pacific DPS. The western Gulf of Alaska also provides important habitat for

beaked whales (primarily Cuvier's, Baird's and Stejneger's), killer whales, minke whales, and various delphinid and porpoise species.

There are four main objectives:

1) *Deploy and recover three passive acoustic recorders deployed in or near the WMA.*
2) *Manually process the acoustic data in the high-frequency band from three existing mooring locations. This frequency band is limited to killer, sperm, and minke whales because of the recorders used.*
3) *Manually extract and classify killer whale calls from these three sites for classifying the calls to ecotype*
4) *Manually process the acoustic data in all frequency bands from the three recorders deployed in 2023. The incorporation of Fpods and Soundtraps should allow for the detection of all calling cetaceans.*

Methods

Field work:

Three deep water subsurface passive acoustic recorder moorings were deployed during the EcoFOCI fall mooring cruise on the F/V Aquila (Figs. 1 & 2). The main leg of the cruise was from 15 Aug through 8 Sep 2023. During this leg, the moorings near Chirikof Island (Fig. 3; CR01) and on Sanak Bank (Fig. 3; SN01) were deployed. Rough weather at the start of the cruise prevented us from reaching the Patton Seamount site (Fig. 3; PT01); funds from this project were used to add two days to the vessel's transit leg from Dutch Harbor to Juneau in order to divert to Patton Seamount, for deployment of that mooring on 11 Sep 2023.

Figure 1. F/V Aquila. Photo: C. Harpold

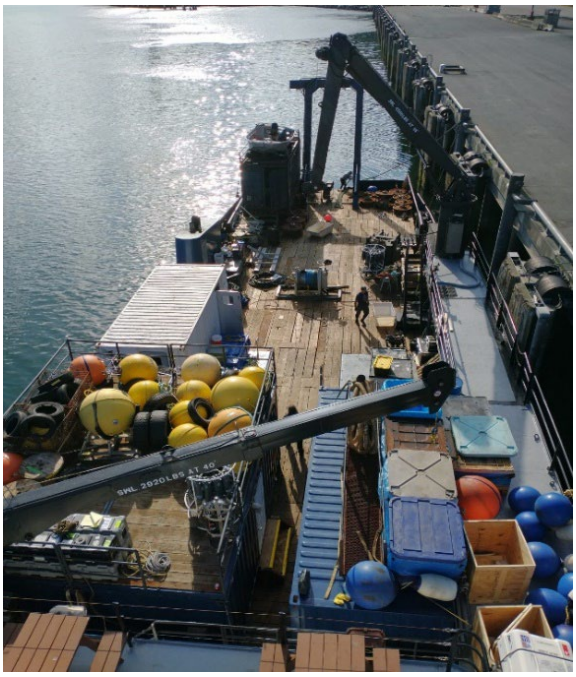

Figure 2: F/V Aquila's back deck looking aft from crow's nest. Photo: C. Berchok

Moorings (see Figure 5 for diagrams; Table 1 for metadata) consisted of a 36" syntactic foam float attached to an 860 lb steel anchor by wire rope,

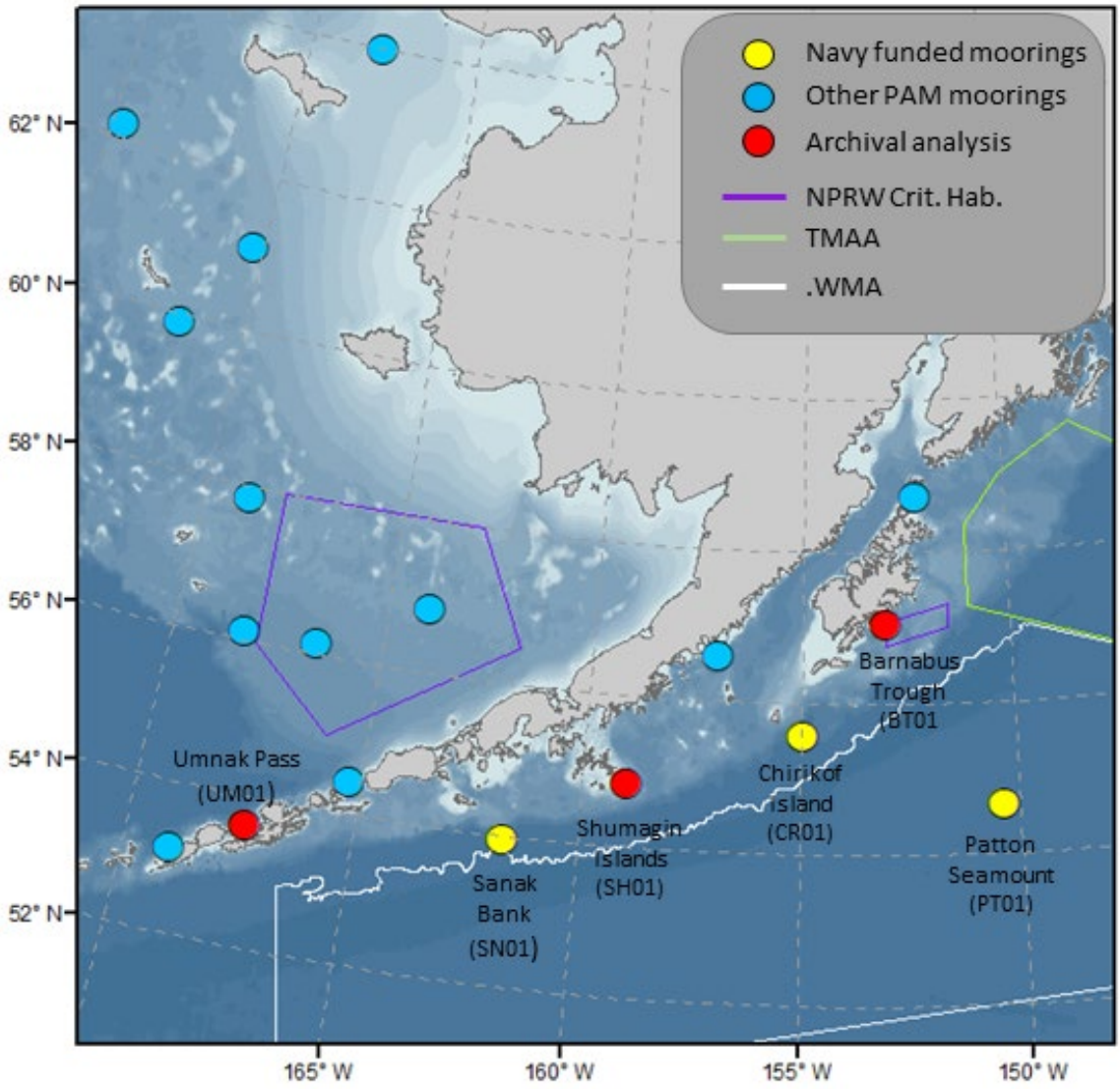

Figure 3. Long term mooring sites. Yellow circles = Deep water moorings funded by the Navy; red circles = moorings chosen for high-frequency analysis and for investigation of killer whale ecotypes; blue circles = other long-term passive acoustic recorder moorings. Purple outline represents North Pacific right whale critical habitat.

Table 1. Moorings Deployed

Mooring	Date/Time deployed (UTC)	Latitude (°N)	Longitude (°W)	Water Depth (m)	Top float depth (m)	Serial Numbers				
						AURAL	ST600	Fpod	deep Fpod	Microcat
SN01	8/18/2023 17:08	53.9727	-161.6678	423	74	102LF	7918	7563		2332
CR01	8/17/2023 6:52	55.5723	-154.9743	406	71	159LF	7861	7541		4078
PT01	9/11/2023 16:07	54.6366	-150.3527	747	71	156LF	7919	7562	7424	1527

Yalex line, and chain. An EdgeTech 8242 Acoustic Release Transponder was attached just above the anchor and will be used to recover each mooring. There were two passive acoustic recorders on each mooring - an AURAL M2 passive acoustic recorder (Multi-Electronique, Rimouski, QC, Canada) at a depth of 200 m as well as a SoundTrap ST600 (Ocean Instruments, Aukland, New Zealand) at a depth of 100m.

The AURAL has a proven 15-year track record for obtaining acoustic recorders in Alaskan waters, but is limited in frequency range (all were set to record at 16 kHz, for a working frequency range of 0-8kHz, and a duty cycle of 80 min of recordings every 5 hours). The ST600 can be set for a higher frequency range (all set to 192kHz; working range 0-96kHz, duty cycle of 4 min of recording every 30 minutes), but has had issues with malfunctioning, including leaking).

There was also an Fpod echolocation detector (Chelonia Limited, Cornwall, UK) installed in the same cage as the ST600. For the Patton Seamount site, a second Fpod was installed at a depth of ~16 m above the seafloor. This second Fpod will allow us to investigate which depth is better suited for detection of beaked whale echolocation. All Fpods will be running continuously (i.e., no duty cycle).

Finally, there was an SBE-37 Microcat (Seabird Scientific, Bellevue, WA) included on each mooring at a depth of 15 m above the seafloor. These instruments, which measure conductivity, temperature, and pressure, were included as part of our ongoing collaboration with Phyllis Stabeno's group at the Pacific Marine Environmental Lab (NOAA-Seattle); her group funded the EcoFOCI fall mooring cruise.

Before each mooring deployment we surveyed the area around our target site, using the ship's depth sounder to find an appropriate water column depth. It was important that the final depth be neither too deep – so that the AURAL, ST600, and regular Fpod instruments would not implode – nor too shallow – to keep the float deep enough to not be a hazard to navigation. Initial target sites were selected to avoid areas with high fishing activity as well as areas too steep to safely support a mooring.

Figure 4. The 2023 EcoFOCI Fall Mooring cruise science party. From left to right: (front row) Ryan McCabe, Savannah Barnard, Colleen Harpold, Liza Hasan, Mike Craig. (back row) Luis Candela, Hongsheng Bi, Dave Kimmel, Catherine Berchok

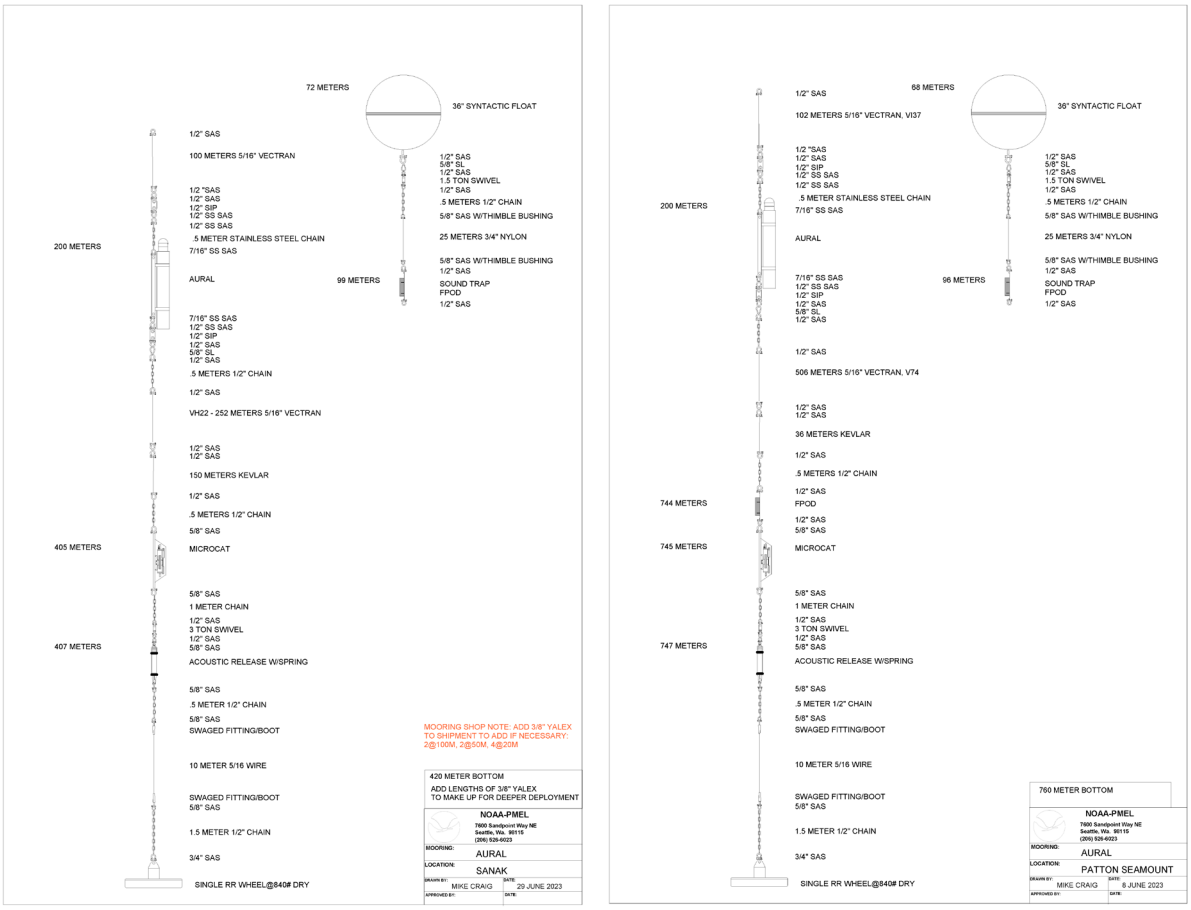

Figure 5. Mooring Diagrams of a) CR01 and SN01 and b) PT01 mooring sites.

Moorings were deployed by placing the float off the port rail with the ship's crane, letting it trail off the stern. The section of the mooring, from the float through the AURAL recorder, was passed off the stern, then the long sections of Yalex and wire rope were spooled off our drag winch, through the block on the A-frame, and off the stern. The mooring line was stopped off on the back deck to insert the deep-Fpod, Microcat, and acoustic release, all of which were passed off the stern. Then the anchor was lifted by the tug winch on the A-frame and released when we passed over our target water bottom depth.

Data Analysis:

The high-frequency-band manual processing followed well-established methods using SoundChecker software for comparability and consistency with our database (Wright et al. 2018). All data (i.e., 100% of sound files) were examined by an expert analyst, specializing in Alaskan species, for the presence of all marine mammal species and anthropogenic sound sources. Data were normalized for effort as the percentage of ten-minute time intervals with the presence of that species or sound source per day.

Results

We have begun to analyze recordings from the high frequency band with our partners at the UW/CICOES through the Navy agreement with CICOES N62473-23-2-0005. Possible species in this band typically include beluga, sperm, minke, and killer whales, bearded and ribbon seals, and ice noise, but for the Gulf of Alaska possible species are limited to killer, sperm, and minke whales. Note that Dahl's and harbor porpoise and beaked whales cannot be detected on our regular passive acoustic recorders (AURALs). Those require Fpod echolocation detectors (and ST600s for beaked whales), which were first deployed in 2023.We chose moorings from three sites, deployed from 2019-2020, to obtain a good set of killer whale calls, to support the next project component that will be differentiating among ecotypes. The first of these three sites, BT01, has been completed, the results of which are shown in Figure 6 with the rest of the detected species from the low and mid-frequency bands (analyzed through other funding). From the high-frequency band, only killer whales were detected, but they were detected on 214 of the 358 days with recordings. Of those days with killer whale detections, there was an average of 6.6% of the recording effort with killer whale calling present (range: 0.4%-37.5%).

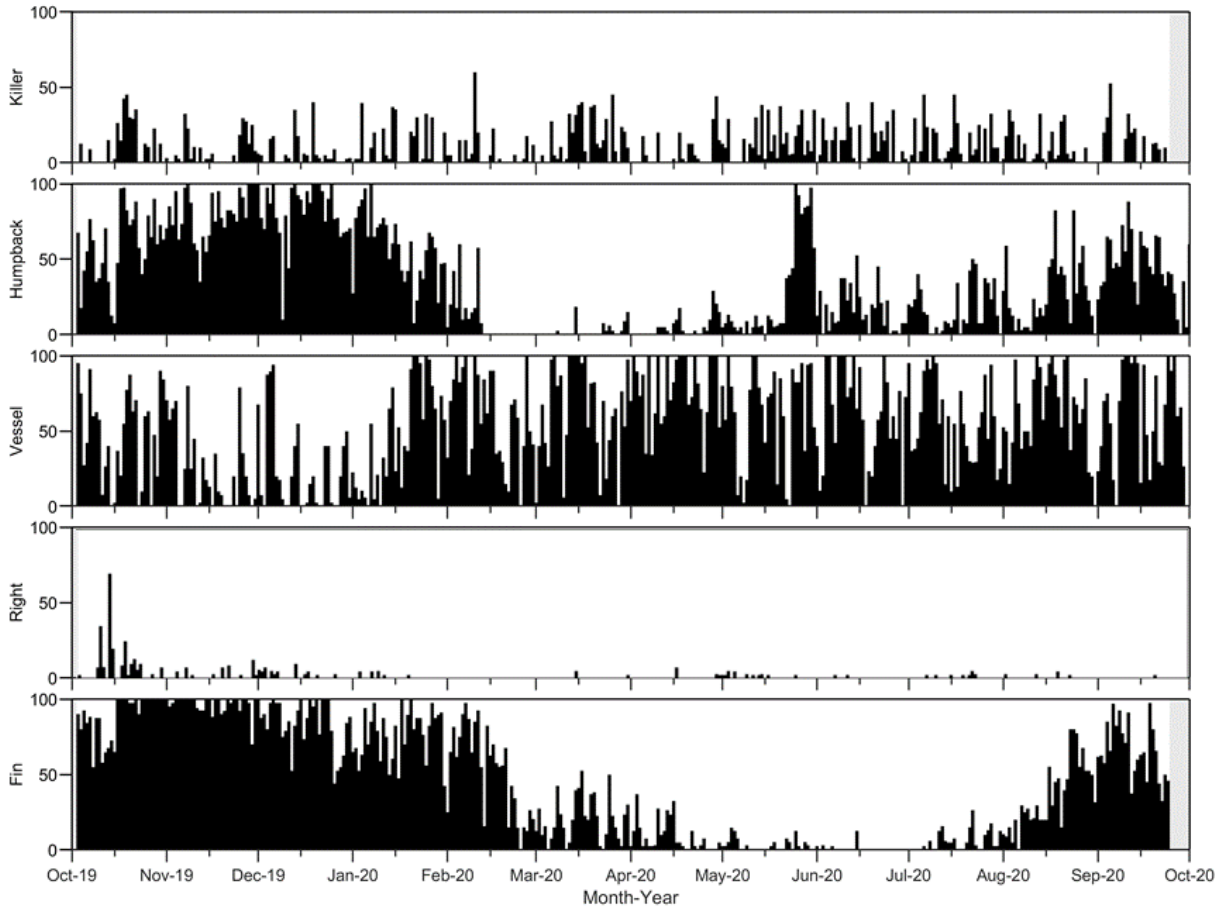

Figure 6. Seasonal distribution of marine mammal species and sound sources at the BT01 mooring site, October 2019 - October 2020. Vertical bars indicate daily calling/noise presence for that species/sound source. Gray shading shows time periods where no data are available.

Upcoming work:

We plan to recover the CR01 and SN01 moorings during the EcoFOCI fall mooring cruise on the NOAA Ship Oscar Dyson (Sept 7-23, 2024). We would need to add at least 1 additional ship day to that cruise to be able to service the mooring at Patton Seamount. Alternatively, we will look into whether the team that services Ocean Station Papa (NOAA weather station buoy; https://www.pmel.noaa.gov/ocs/Papa) could service PT01 as well, since they will be passing nearby to the site. Their cruise occurs in early February each year. Although this would result in a very shortened time record if they recovered our mooring in 2024, leaving PT01 in until Feb of 2025 could be a good workable option (and the AURAL recorder should last through December 2024).

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